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DEPARTMENT OF AGRICULTURE

REPORT

ON

COLD STORAGE CONDITIONS FOR EXPORT FRUIT

AT CAPETOWN

By I. B. POLE EVANS, M.A., D.Sc., F.L.S.

Chief, Division of Botany and Plant Pathology

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WASTAGE IN CITRUS FRUIT SHIPPED FOR EXPORT.

Report, dated 17th December, 1919, by I. B. Pole Evans, M.A., D.Sc., F.L.S.,
Chief, Division of Botany and Plant Pathology,
to the Secretary for Agriculture.

Considerable wastage having occurred in shipments of citrus fruits which were exported during the past season (1919), suggestions were made in various quarters that such wastage might possibly be attributed to insanitary conditions prevailing in the fruit trucks, cold stores, and ship's cool chambers, which carried the fruit. As soon as the matter was brought to the notice of the Department of Agriculture, the Minister requested me to give it attention, and I recently visited Capetown with this object in view.

Through the courtesy of Sir William Hoy, General Manager of the South African Railways and Harbours, Mr. Duff, General Manager of the Union-Castle Steamship Company, and Mr. Wright, Branch Manager of the Imperial Cold Storage, Capetown, every facility was given me for inspecting and examining the fruit trucks, cold stores, and ship's cool chambers mentioned herein, and to these gentlemen I wish to express my appreciation for the assistance which they have rendered. Before carrying out the actual tests for the presence of fungus spores in the various cool chambers, I first made a preliminary inspection of the chambers at the Government Cold Stores and the Imperial Cold Storage Company at the Docks, and then arranged to make the mycological tests in the fruit trucks, Government Cold Stores, Imperial Cold Stores, and "Balmoral Castle" simultaneously on the same day, so that the exposures might be made under similar circumstances and the resulting growths might be kept under uniform conditions for further observation and study.

I visited the Government Cold Storage chambers at the Docks on 25th November in company with Mr. Girdwood of the Railways and Harbours. Here the Fruit Inspector showed me first of all the six cool chambers which were erected in 1908. The chambers were not in working order and had not been fumigated or sterilized since they had contained last season's stock of fruit.

The chambers were all empty and as far as the eye could see were clean, well looked after, and well kept. I could detect no unhealthy or abnormal smell in any of them, but the passage-way on the quay side leading from the cool chambers to the boat had a distinctly musty smell.

I then examined the cool chambers, five in number, which were erected in 1902. I found these chambers clean and well kept, but in comparison with the ones previously examined they had a distinctly musty and mouldy smell about them.

From here I went to the Imperial Cold Storage Company, where the Branch Manager, Mr. Wright, and the Consulting Engineer, Mr. Catell, were good enough to allow me to inspect the chambers which are usually used for the storage of fruit. I was first shown Chamber No. 17, where a large quantity of export citrus fruit had been stored. On entering the chamber a distinctly mouldy smell was noticed, and three broken boxes containing mouldy oranges, bearing a label on the outside "Rustenburg Boeren Co-op," were lying on the floor.

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I was next shown Chamber No. 13, which also had a very pronounced musty and mouldy smell about it. It contained a number of boxes of apples, and it was at once evident that considerable decay was going on in some of the boxes as there was a heavy growth of green mould on many of them. Some broken boxes with mouldy fruit were also lying on the floor in this chamber.

I was next shown Chamber No. 20, which contained a considerable amount of beef. Nothing abnormal was detected here.

Finally I was shown Chamber No. 23, which contained a considerable number of boxes of eggs. Nothing unusual was detected here.

The " Balmoral Castle " arrived at Capetown from the coast on the 3rd instant and the following were examined on the same day :—

I. *South African Railways*—
1. Fruit Truck No. 37614.
2. Fruit Truck No. 10873.

II. *Government Cold Stores*—
1. Chambers Nos. 1 to 5, together with entrance and exit passages.
2. Chambers Nos. 6 to 11 and entrance passage.

III. *Imperial Cold Storage*—
Chambers Nos. 13, 17, 20, and 23.

IV. " *Balmoral Castle* "—
Chambers D, G, and Thermo-chambers.

V. *Parliament Street.*

As regards the inspection and examination of the trucks belonging to the South African Railways, it should be noted that Fruit Truck No. 37614 was what is commonly known as " a short." The roof, floor, and ends were constructed of wood, while the sides were enclosed by wooden lathes over which strong wire gauze was stretched. Fruit Truck No. 10873 was what is known as " a bogie," and was divided into two separate compartments. Its construction was otherwise similar to the previous truck, except that the wire gauze was of wider mesh. Both trucks had some scattered grains of maize on the floors, showing that they had recently been used for the transportation of this commodity. The test plates were exposed at floor level and at the centre of the trucks.

With respect to the Government Cold Stores they were in the same condition as when I first inspected them. They were all empty. When the tests were made in Shed No. 1, which contained the first five Government Cool Chambers, no circulation of air was taking place in the chambers. The plates were exposed in the centre of the chambers and near the exit. Both entrance and exit passage were also tested.

When the tests were carried out in Shed No. 2, which contained the remaining six Government Cool Chambers, the circulation of cool air through the chambers was taking place. Plates were exposed in the centre and near the exit of the chambers and an exposure was also made in the entrance passage to the chambers where fruit is frequently stored prior to being placed inside.

Concerning the tests made at the Imperial Cold Storage Company, Chamber No. 13 was found in much the same condition as when the inspection was made on 25th November. It still contained boxes of apples, had a very pronounced mouldy smell, and some mouldy apples were lying about on the floor.

Chamber No. 17, however, had received attention since my first inspection. The upper room had been whitewashed and cleaned, while the lower room was being whitewashed, and Mr. Catell informed me that the ozonator which the Company use for disinfection purposes had been at work in it. The strong mouldy smell which was so noticeable in this chamber at the first visit could no longer be detected.

Chamber No. 20 had also been overhauled since my previous inspection. The meat had been removed, the pipes had been defrosted, and the floor had been covered with sawdust. The chamber had a strong smell of ammonia, due, I was told, to a pipe-burst.

Chamber No. 23 appeared to be in the same condition as when I first saw it. It contained a large number of boxes of eggs, was in a clean condition, and no unwholesome smell could be detected.

On the " Balmoral Castle " it was only possible to examine three chambers, viz., D and G in No. 3 hatch and the thermo-chamber in No. 4 hatch, all the other chambers being full of cargo.

In D chamber beef was stored, while G chamber was empty. No unwholesome smell could be detected in either of these. Cargo was being loaded in the thermo-chamber, and I was told it consisted mostly of sugar and wattle-bark extract. Four plates were exposed in different parts of this chamber. Two plates were finally exposed in Parliament Street outside the Department's offices there, merely to serve as a control and guide to the state of the atmosphere prevailing in Capetown at the time.

The same method of procedure was adopted in all cases where the atmosphere was examined. Sterilized Petri dishes of prune agar were exposed for 5 and 15 seconds respectively to the suspected atmosphere, and the resulting growths examined and noted.

Three distinct moulds which cause decay in apple and citrus fruits were eventually found, viz., the Grey-green Mould—*Penicillium expansum* Link.—which causes rot in apples and allied fruits ; the Olive-green Mould—*Penicillium digitatum* Sacc.—which causes decay in citrus fruits ; and the Blue-green Mould—*Penicillium italicum* Wehmer.—which also produces rot in citrus fruits.

The details of the tests made and the various growths obtained are shown in the attached table.

From this it will be seen that—

I. the *South African Railways,* from 6 exposures extending over a period of 60 seconds in two fruit trucks, yielded 4 growths of fruit-rotting fungi, which gives an average of ·6 infection per unit-surface exposed ;

II. the *Government Cold Stores*—

(*a*) from 22 exposures made in 11 chambers over a period of 220 seconds yielded 43 growths of fruit-rotting fungi, which gives an average of 1 ·95 infection per unit-surface exposed ;

(*b*) from 3 exposures in passages adjoining cool chambers lasting over 45 seconds gave 22 growths of fruit-rotting fungi, which averages about 7 ·4 infection per unit-surface exposed ;

III. the *Imperial Cold Storage,* from 10 exposures in 4 chambers extending over a period of 100 seconds yielded 1557 growths of fruit-rotting fungi, which gives an average of 155 ·7 infection per unit-space exposed ;

IV. the " *Balmoral Castle,*" from 8 exposures in 3 chambers lasting over 80 seconds yielded 162 growths of fruit-rotting fungi, which gives an average of 20 ·2 infection per unit-space exposed ;

V. the atmosphere in Parliament Street showed no contamination from fungi. This is rather remarkable and needs further investigation.

The amount of fungus contamination found in the various places tested may, therefore, be summed up as follows:—

1. South African Railways..... ·6
2. Government Cold Stores..... 4·67
3. "Balmoral Castle"..... 20·2
4. Imperial Cold Storage..... 155·7

As a result of this investigation I do not consider that the decay of fruit for export can be attributed to unsatisfactory conditions prevailing in the railway trucks, or at the Government Cold Stores at the Docks, for the fungus contamination found in both is comparatively small. Attention, however, should be paid to the thorough disinfection of the passage-ways leading to and from the cool chambers in the Government sheds. The contamination found in the chambers of the "Balmoral Castle" though not high, might well be reduced by more frequent disinfection.

Some of the chambers at the Imperial Cold Storage Company reveal a most unsatisfactory state of affairs, and one which needs prompt attention, for articles from such heavily contaminated atmosphere, whether they become infected or not, are liable to spread infection wherever they are subsequently stored or handled.

To make this investigation complete I am of opinion that further inspections and tests should be carried out not only on all those ships which usually carry fruit to Europe, but also in the orchards and packing sheds where the fruit receives most of the handling and where it is most exposed.

Arrangements will be made to carry out a similar series of tests in the orchards and packing-houses during the coming season, while the ships' cold storage accommodation can be tested as soon as a mycological laboratory is established and equipped at Capetown.

With such an ideal climate as prevails in the Transvaal and many other citrus-producing areas in the Union, when the fruit is picked and packed, there should be no loss from decay, if the necessary and simple precautions with regard to picking, handling, packing, and general sanitation are observed.

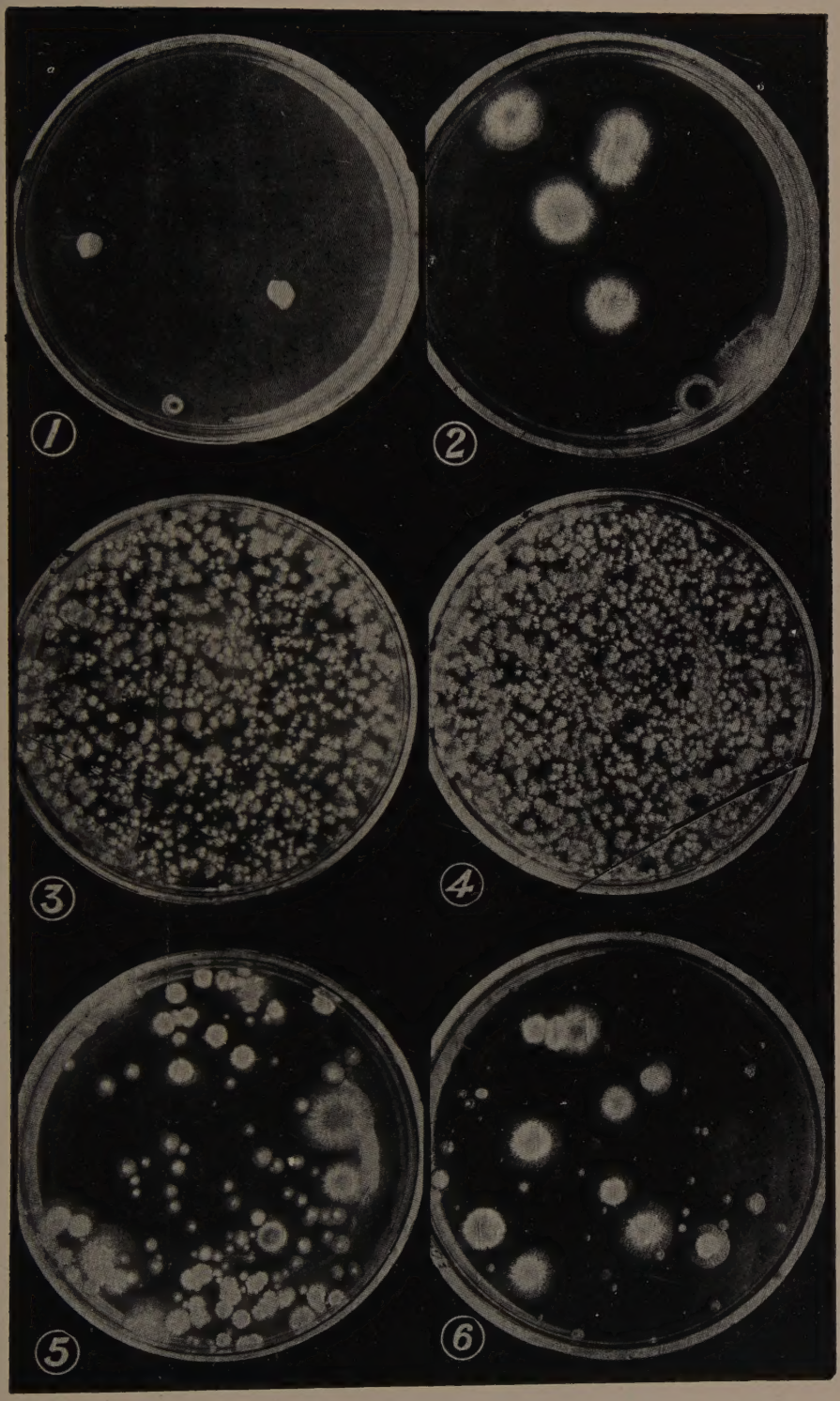
SCHEDULE.

SHOWING NUMBER AND VARIETY OF GROWTHS ON EXPOSED PLATES.

Place where Test was Made.	Number of Chamber.	Time of Exposures in Seconds.	Number of Growths of Grey-green Mould (*P. expansum*) Producing Apple Rot.	Number of Growths of Olive-green Mould (*P. digitatum*) Producing Citrus Rot.	Number of Growths of Blue-green Mould (*P. italicum*) Producing Citrus Rot.	Total.	Remarks.
I. South African Railways. Truck No. 37614.	Short truck.	5 15	1 —	— —	— 2	3	—
Truck No. 10873.	Bogie compartment. 1 2	 5 15 5 15	 — 1 — —	 — — — —	 — — — —	1	See photo. No. 1. Plate also shows two pink colonies of yeast.
II. Government Cold Stores. Shed No. 1.	1	5 15	— —	1 —	— —	1	Air not circulating.
	2	5 15	— 3	1 —	1 —	5	Air not circulating.
	3	5 15	— —	— —	— —	—	Air not circulating.
	4	5 15	— 2	1 —	1 —	4	Air not circulating.
	5	5 15	2 —	1 —	5 5	13	See photo. No. 2. Air not circulating.

Place where Test was Made.	Number of Chamber.	Time of Exposures in Seconds.	Number of Growths of Grey-green Mould (*P. expansum*) Producing Apple Rot.	Number of Growths of Olive-green Mould (*P. digitatum*) Producing Citrus Rot.	Number of Growths of Blue-green Mould (*P. italicum*) Producing Citrus Rot.	Total.	Remarks.
Government Cold Stores. Shed No. 2.	6	5 15	3 —	1 —	2 1	7	Cool air circulating.
	7	5 15	— —	— —	— —	0	Cool air circulating.
	8	5 15	4 —	1 —	2 —	7	Cool air circulating.
	9	5 15	— 2	— 1	— 2	5	Cool air circulating.
	10	5 15	— —	— —	— —	0	Cool air circulating.
	11	5 15	— —	— —	— 1	1	Cool air circulating.
Entrance Passage, No. 1, Cold Storage.	—	15	2	8	1	11	—
Exit Passage, No. 1, Cold Stores.	—	15	—	3	4	7	—
Entrance Passage, Government Cold Stores, No. 2.	—	15	3	1	—	4	—

Place where Test was Made.	Number of Chamber.	Time of Exposures in Seconds.	Number of Growths of Grey-green Mould (*P. expansum*) Producing Apple Rot.	Number of Growths of Olive-green Mould (*P. digitatum*) Producing Citrus Rot.	Number of Growths of Blue-green Mould (*P. italicum*) Producing Citrus Rot.	Total.	Remarks.
III. Imperial Cold Storage.	13	5 15	495 689	8 13	— —	503 702	See Photo No. 3 / See Photo No. 4 { Very musty smell. Cases of apples being stored. Mouldy apples lying about.
	Basement.	5	—	—	36		Walls and roof being whitewashed; when exposures were made ozonator had been at play.
	17	15	—	1	69	106	
	Top floor.	5	—	—	29		Walls and roof had just been whitewashed; prior to exposures being made ozonator had also been at work.
	17	15	—	—	59	88	
	20	5 15	1 6	— —	29 120	156	Strong smell of ammonia in chamber, owing to pipe-burst. Pipes had been defrosted; floor covered with sawdust (see photo No. 5).
	23	5 15	— —	— 2	— —	2	Chamber about three-parts filled with egg-boxes.
IV. "Balmoral Castle."	D.	5 15	— —	— 54	44 9	107	Beef being stored here (see photo No. 6).
	G.	5 15	— —	— —	8 10	18	Chamber empty; heavy frost on pipes.
	Thermo	5 15	5 3	— —	— 10	18	Sugar and wattle-bark extract being stored here.
	Thermo	5 15	2 3	— —	3 11	19	Sugar and wattle-bark extract being stored here.
V. Parliament Street.	—	5 15	— —	— —	— —	—	No contamination.



Growths of fruit-rotting fungi from :—

Fig. 1. South African Railway Truck No. 10873.	Fig. 2. Government Cold Storage. Chamber No. 5.	Fig. 3. Imperial Cold Storage. Chamber No. 13.
Fig. 4. Imperial Cold Storage. Chamber No. 13.	Fig. 5. Imperial Cold Storage. Chamber No. 20.	Fig. 6. "Balmoral Castle." D Chamber.

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